Discovery, The Student Journal of Dale Bumpers College of Agricultural, Food and Life Sciences

Volume 1 Article 12

Fall 2000

Abstracts From the Student Presentations of the Arkansas Chapter of Gamma Sigma Delta

Discovery Editors

Student presentations of the Arkansas Chapter of Gamma Sigma Delta

Competition of February 9, 2000

COMPETITION WINNERS

Posters

First Place: Svetlana Zivanovic–Food Science
Second Place: Marlene E. Janes–Food Science
Third Place: Karen Gomez–Crop, Soil, and Environmental Sciences

Undergraduate Papers

First Place: Joyce Jong–Poultry Science
Second Place: Chrislyn Drake–Horticulture
Third Place: Jerry Fendley–Biological and Agricultural Engineering, Food Science

Master's Papers

First Place: Thomas Barber–Crop, Soil, and Environmental Sciences
Second Place: Jeff Weyers (Animal Science)
Third Place: Mike Lovelace–Crop, Soil, and Environmental Sciences

Ph.D. Papers

First Place: Richard Musser (Entomology)
Second Place: Satyendra Rajguru–Crop, Soil, and Environmental Sciences
Third Place: Scott Payne–Crop, Soil, and Environmental Sciences

DETERMINATION OF CHILLING REQUIREMENT OF ARKANSAS BLACKBERRY CULTIVARS

Chrislyn A. Drake and John R. Clark,
Department of Horticulture

Little research has been done to determine the chilling requirement for Arkansas blackberry cultivars. However, field observations from areas where low amounts of chilling occur indicate that Navaho requires more hours of chilling than does Arapaho. The objective of the study was to determine a method for measuring chilling requirement using whole plants of two blackberry cultivars, Arapaho and Navaho. One-year-old bare-root plants were field-dug and placed in a cold chamber at 3ºC. Ten single-plant replications of each cultivar were removed at 100-hour intervals up to 1000 hours. The plants were then potted and placed in a greenhouse (daily minimum temperature 15ºC) in a completely randomized design. Budbreak was recorded on a weekly basis. Data for budbreak were analyzed as a two-factor factorial (2 cultivars and 10 chilling treatments) by SAS and means separated by LSD ($P = 0.05$). Data indicated that the chilling requirement for Arapaho is between 400 and 500 hours. This is evident as a sixfold increase, which was the largest increase between two chilling treatments, occurred between 400 and 500 hours. For Navaho, the largest increase (also sixfold) occurred between 800 and 900 hours, which indicated a chilling requirement for Navaho of 800 to 900 hours. These data support previous observations and indicate the method used was successful in determining chilling requirement for blackberries.

FISSURE CHARACTERIZATION OF RICE KERNELS USING VIDEO MICROSCOPY

Jerry W. Fendley and Terry J. Siebenmorgen,
Departments of Biological and Agricultural Engineering and Food Science

Fissures (cracks) in rice kernels created during the drying and tempering process cause tremendous postharvest losses in milling yield. Understanding the mechanism of fissure formation in rice kernels will lead to optimizing rice drying and tempering operations. This understanding will enable current dryers to be operated in the most productive and efficient manner possible, thus conserving energy, improving milling yields, and maximizing throughput of dryers. It will ultimately lead to innovative drying equipment and processing design. The ability to produce kernels with little or no fissuring could also dramatically improve end-use processing operations that rely on cooking and puffing procedures. Finally, this information could provide inputs to plant breeders for producing rice cultivars that are more resistant to fissuring. An environmental chamber with video microscopy equipment was used to detect fissures in rice kernels. The video microscope system captured the images of brown rice kernels while being dried. Images of kernels were recorded continuously. Fissure formation, particularly initiation and propagation, was investigated by reviewing the recorded images. This feature of the research is anticipated to be of direct importance to end-users of rice, including cereal and cooked-rice product manufacturers that rely on kernel physical integrity for optimum processing performance. To ensure accurate results, at least five kernels were tested from each harvest moisture content (MC) lot from each cultivar for each drying air condition selected. Differences in fissuring behavior were expected with different kernel MCs. This is of importance because of the different MCs under which rice is harvested and processed.

LIVABILITY OF LEGHORN BALUT EMBRYOS STORED UNDER VARYING TEMPERATURE AND STORAGE TIMES

Joyce Jong and Dustan Clark,
Department of Poultry Science

Baluts are fertile chicken or duck eggs that have been incubated and removed from the incubator prior to hatching. Chicken eggs are incubated for 11 to 14 days and 16 and 20 days for duck eggs. This is a food product with an extremely specialized consumer market, with the majority of its consumers of Filipino decent. Current USDA regulations for the storage of baluts prior to sale is 7.2ºC, the same as for infertile commercial table eggs. Consumer preference is to purchase live baluts for consumption. Since exposure to 7.2ºC causes embryo mortality within 48 hours of removal from an incubator, research was performed to assess mortality at various storage temperatures. Livability of embryos, after removal from incubators, when exposed to various storage temperatures has not been established. A study consisting of two identical trials was conducted to determine liv-

ability of embryos when exposed to varying temperatures over predetermined storage times. Fertile Leghorn chicken eggs were incubated for 13.5 days and then removed from incubation, grouped, and placed in temperature-controlled environments of 15.6, 18.3, and 22.2°C. At predetermined time intervals, eggs were opened to determine embryo viability. Random swab samples of the internal egg environment were also aseptically taken to determine presence of microorganisms. Results demonstrated that the livability of embryos was longer when exposed to storage temperatures closer to incubation temperatures (37.5°C), and livability was shorter when storage temperatures neared refrigeration temperature (7.2°C).

GROWTH PERFORMANCE OF BROILER CHICKS DURING THE STARTER AND GROWER PHASES WHEN UTILIZING PHASE-FEEDING

Niki Loupe and Jason L. Emmert,
Department of Poultry Science

An experiment was conducted to evaluate the efficacy of a nutritional program referred to as phase-feeding (PF) over the first 6 weeks posthatching. Diets were formulated using amino acid recommendations from the National Research Council (NRC) (1994) or from linear regression equations generated from best estimates of lysine (Lys), sulfur amino acid (SAA) and threonine (Thr) requirements. Regression equations were used to predict weekly Lys, SAA and Thr requirements for use in a PF regimen that involved lowering amino acid levels following each respective week of the experiment, resulting in 6 diets fed over the six-week period. During the starter period (0 to 3 weeks), PF resulted in a slight increase ($P < 0.05$) in weight gain and weight gain per unit of digestible Lys and SAA intake. Phase-feeding also resulted in improved weight gain during the grower period (3 to 6 weeks). Over the entire experiment (0 to 6 weeks), the PF regimen resulted in an increased ($P < 0.05$) weight gain, feed intake, and weight gain per unit digestible Lys, SAA and Thr intake compared to birds fed diets based on NRC requirements. These data suggest that PF during the first 6 weeks of age can support growth comparable to diets formulated using NRC requirements. Because PF diets contain substantially less protein and lead to an increased efficiency of utilization of Lys, SAA and Thr, substantial economic benefits may result from the use of PF.

GRADUATE PH.D. ORAL PAPER COMPETITION

EVALUATION OF TANK-MIX COMBINATIONS OF CLORANSULAM AND GLYPHOSATE FOR WEED CONTROL IN SOYBEAN

Jeff W. Barnes and L. R. Oliver,
Department of Crop, Soil, and Environmental Sciences

Field and greenhouse experiments were conducted in 1998 and 1999 to determine the weed control potential of cloransulam and glyphosate tank-mix combinations. The experimental design for all experiments was a factorial arrangement of treatments conducted in a randomized complete block design with four replications. The factors consisted of four cloransulam application rates (0, 4.5, 9, and 18 g ai/ha) and four glyphosate rates (0, 420, 560, 840). In field experiments, weed control evaluations were taken 2 and 3 weeks after treatment. In the greenhouse, the plants were harvested 2 weeks after treatment and fresh weights were determined. The fresh weight data were converted to percent of the untreated control treatment. All data were subjected to analysis of variance and were combined over runs of each respective experiment type. To determine whether the tank-mix combinations provided additive, antagonistic, or synergistic responses, expected values were calculated by Colby's method. Cloransulam at 18 g ai/ha provided at least 60% control of the morningglory species and velvetleaf under both field and greenhouse conditions. Glyphosate provided at least 55% control of sicklepod, prickly sida, Palmer amaranth, and smooth pigweed. Of the 112 treatment combinations evaluated, 56 antagonistic and 56 additive responses were observed. Of the 56 antagonistic interactions observed, only nine resulted in weed control that was significantly lower than the herbicides provided when applied alone. These nine severe antagonistic interactions were confined to entireleaf morningglory and sicklepod. The other six weed species exhibited varying levels of antagonism. In general, combinations of cloransulam with glyphosate resulted in a broader weed control spectrum than when the herbicides were applied alone.

WATER DEFICIT AND K PARTITIONING IN COTTON

Dennis L. Coker and Derrick M. Oosterhuis,
Department of Crop, Soil, and Environmental Sciences

The impact of water deficit on K deficiency and partitioning in the cotton (*Gossypium hirsutum*) plant beginning at the peak boll development stage is not well understood. Inconsistent yield responses to soil and foliar-applied K fertilizers may be related to water deficit stress from irrigated or rain fed systems. Cotton growth, lint yield, and K partitioning under limited K and water were studied in a field environment. Eight treatment combinations of well-watered or dryland conditions, high or low soil K, and with or without foliar-applied K were arranged in a split-split plot design with six replications. Growth, dry matter, leaf photosynthesis, and K concentration in above-ground organs were measured at key phenological stages [pinhead square (PS), first flower (FF), first flower + 3 weeks (FF+3), and first flower + 5 weeks (FF+5)]. Final lint yield was determined by a mechanical harvester, and components of yield were determined by hand-harvesting. At FF+3 (peak boll development stage), stem and petiole K concentration was significantly reduced ($P \leq 0.05$) from high to low soil K under the well-watered but not the dryland condition. Foliar K consistently increased stem, petiole, and leaf K concentration under the low soil K condition only. Foliar K increased leaf K concentration by a greater margin under dryland, low soil K compared to well-watered, low soil K conditions. Lint yield responded best to foliar K under low soil K and under well-watered conditions. Potassium deficiency in cotton appeared to be enhanced by water deficit, although water deficit did not reduce the efficacy of foliar-applied K.

CATERPILLAR SALIVARY ENZYMES: ROLE IN THE MANIPULATION OF HOST PLANT DEFENSES

Richard O. Musser and Gary W. Felton,
Department of Entomology

Saliva from *Heliocoverpa zea* (corn earworm) larvae was examined for the suppression of the inducible plant defenses of *Nicotiana tabacum* (tobacco). Larval spinnerets were ablated, inhibiting normal secretions of saliva. These larvae and sham larvae were individually caged on a single plant for 24 hours. Three days after feeding, the damaged leaf was analyzed for nicotine, an inducible defense. It was determined that leaves that were fed on by the sham larvae had significantly lower levels of nicotine compared to the ablated treatment. The salivary enzyme glucose oxidase (GOX) was purified from the larval labial glands. Leaves were damaged with a cork borer to simulate insect damage. A leaf was treated with one of four treatments: (1) purified GOX, (2) labial gland extract, (3) autoclaved GOX, or (4) water. Leaves treated with glucose oxidase or labial gland extracts had significantly lower levels of nicotine and polyphenol oxidase compared to other treatments. Neonate growth was also analyzed on leaves treated with either GOX or water. Larval weight was significantly higher for larvae that fed on leaves treated with GOX than those that fed on leaves treated with water. This was the first time that insect saliva in situ has been shown to alter a host plant's inducible defenses and the first time that any characterized insect-derived chemical has been shown to suppress induced resistance in plants.

EFFECT OF LOW CONCENTRATIONS OF GROWTH REGULATORS ON GLYPHOSATE EFFICACY

Scott A. Payne, N. R. Burgos, and L. R. Oliver,
Department of Crop, Soil, and Environmental Sciences

Studies were conducted to examine the effects of the addition of low concentrations of growth regulators and growth regulator-type herbicides on glyphosate efficacy and soybean injury. In preliminary field and greenhouse studies, the addition of indole-acetic acid and gibberellic acid to glyphosate did not improve the control of entireleaf morningglory, hemp sesbania, velvetleaf, or prickly sida. A separate field study consisted of glyphosate applied alone at 0.56 or 1.12 kg ai/ha or glyphosate applied at 0.56 kg/ha with a growth regulator herbicide (2,4-D, dicamba, quinclorac, or triclopyr) applied at 1/10 its labeled rate. The addition of dicamba, quinclorac, and 2,4-D to 0.56 kg/ha glyphosate improved glyphosate activity on entireleaf morningglory at 2 weeks after treatment (WAT). Hemp sesbania control by glyphosate was improved by the addition of 2,4-D or dicamba from 80 to 95%, respectively. A greenhouse study was conducted using a factorial arrangement of treatments that included a growth regulator herbicide at 1/10 or 1/100 the labeled rate applied alone or with 0.56 kg/ha glyphosate. Growth regulators included 2,4-DB

and clopyralid as well as those used in the field study. Soybean Asgrow 5601 RR and weed species previously mentioned were harvested for dry weight at 2 WAT. The addition of dicamba to glyphosate resulted in 33% soybean dry weight reduction, but 2,4-DB or quinclorac plus glyphosate had no effect. Biomass reduction of entireleaf morningglory by glyphosate + 2,4-D, quinclorac, or triclopyr was increased over that by glyphosate alone (about 70% as compared to 55%). Clopyralid or quinclorac plus glyphosate produced among the highest hemp sesbania dry weight reduction. No growth regulator plus glyphosate combination caused greater dry weight reduction of velvetleaf or prickly sida as compared to glyphosate alone.

DEVELOPMENT OF A TRANSFORMATION CONSTRUCT FOR ENHANCED DISEASE RESISTANCE

Satyendra Rajguru and James McD. Stewart,
Department of Crop, Soil, and Environmental Sciences

Magainins are 23-residue antibiotic peptides derived from the skin of the African clawed frog (*Xenopus laevis*). They inhibit the growth of numerous species of bacteria and fungi by depolarizing cell membranes and making cells leaky to the environment. Importantly, they arrest the growth of some important fungal and bacterial pathogens that affect cotton and various other crop species. The objective of this research was to study the cytotoxicity of magainin on chloroplasts and to incorporate the gene-encoding magainin into tobacco and eventually cotton to enhance the resistance to various disease causing pathogens. Chloroplasts isolated from pea seedlings were treated with magainin. Lysis of chloroplasts was measured as a function of decrease in the chlorophyll concentration in the treated samples as compared with the untreated controls. Polymerase chain reaction (PCR) was utilized to synthesize the magainin gene, and the PCR product was cloned into binary vector pBIN-GFP. Tobacco leaf discs were co-cultivated with *Agrobacterium* and transgenic plants were generated. Preliminary confirmation of transgenic plants was performed by PCR. Future studies involve confirmation of the integration event by Southern blot and the gene product by Western blot. Transformed tobacco and cotton plants will be tested against a variety of fungal and bacterial pathogens. We expect that the incorporation of magainin into cotton plants should increase their resistance to various pathogens and would provide an alternative approach to controlling diseases in crop plants.

EVIDENCE OF HEPATIC AND EXTRA-HEPATIC STIMULATION OF GLUTATHIONE RELEASE BY NOREPINEPHRINE in vivo

Zhenyuan Song, D. Cawthon, K. Beers and Walter Bottje,
Department of Poultry Science

The present study was conducted to determine the effect of norepinephrine (NE) on glutathione (GSH) export from hepatic and extra-hepatic tissues in vivo. In Experiment 1, anesthetized single-comb white Leghorn males were implanted with cannulae in the carotid artery, hepatic vein (HV), hepatic portal vein (PV) and left bile duct. Norepinephrine [2 and 10 μg/minute/kg body weight (BW)] was infused into the PV for 20 minutes in each bird. Mean arterial pressure (MAP), hepatic venous pressure, portal venous pressure, as well as GSH and oxidized GSH levels in HV, PV, and bile, were monitored at 5- to 20-minute intervals prior to, during, and following NE infusions. NE-induced increases in MAP were concomitant with decreases in heart rate, but no changes in pre-, post-, and trans-hepatic pressures were observed except with the higher dosage of NE (10 μg/minute/kg BW). Although NE had no effect on biliary GSH secretion, both NE infusions raised GSH levels in the HV. GSH levels in the PV increased only in response to the higher dosage of NE. In Experiment 2, pretreatment of birds with phentolamine, an alpha-adrenergic receptor antagonist, abolished the ability of the liver to export GSH and the ability of the infusion of NE (10 μg/minute/kg BW) into the PV to stimulate GSH release by hepatic and extra-hepatic tissue. The results are the first to demonstrate that export of GSH into plasma in vivo is mediated by an alpha-receptor mediated mechanism in hepatic and extra-hepatic tissues.

INFLAMMATION-INDUCED CHANGES IN CHICKEN SERUM

Hang Xie and Narayan Rath,
Department of Poultry Science and USDA/ARS/PPPSRU

Inflammation and infection induce changes in the levels of hormones, cytokines, and other regulatory proteins that function to restore physiological homeostasis. These acute-phase changes often manifest in blood, which can potentially be used as markers of health problems. We

have used this concept to study the changes in chicken sera derived from experimental inflammation induced systemically by intravenous injection of bacterial endotoxin or locally by subcutaneous injection of croton oil. Endotoxin induced elevation in the serum level of interleukin-6, a proinflammatory cytokine, within 24 hours, which subsided by 48 hours. We also found that both endotoxin- and croton oil- induced inflammations resulted in changes in the levels of several serum proteins that included elevation in transferrin and alpha-1 acid glycoprotein, and reduction in the level of albumin. To investigate the significance of these acute-phase changes, we tested the effects of inflammatory sera from 48-hour croton oil injected chickens on a chicken macrophage cell line in culture. The results showed that inflammatory sera augmented the endotoxin-induced production of both reactive oxygen and nitrogen species by macrophages without having any effect on interleukin-6 production. These results suggest that components of inflammatory sera can modulate innate immunity by influencing effector cells such as macrophages. The changes in serum can be used as markers of health status of poultry during production as well as antemortem inspection for the purpose of food safety.

GRADUATE M.S. ORAL PAPER COMPETITION

ALTERNATIVE HERBICIDE PROGRAMS FOR DICLOFOP-RESISTANT RYEGRASS IN WHEAT

L. Thomas Barber, L.R. Oliver and F.L. Baldwin, Department of Crop, Soil, and Environmental Sciences

Ryegrass (*Lolium* sp.) is a major problem weed in Arkansas wheat production. With the increasing spread of diclofop (Hoelon)-resistant ryegrass across the state, alternative herbicide programs are needed to provide adequate control of the ryegrass. Studies were conducted at Fayetteville on a silt loam and at Willow Beach on a clay loam. A population of diclofop-resistant perennial ryegrass (*Lolium perenne*) was present at both locations. Pioneer wheat cultivar 2684 was drilled in 7-in. rows at a rate of 100.9 kg/ha. The study was a randomized complete block with four replications and a plot size of 3.1 by 7.4 m. Treatments were sprayed with a backpack sprayer at 186.8 L/ha. Visual ratings were taken 3, 6, and 12 weeks after emergence (WAE) and at 30 WAE or harvest. Data were subjected to analysis of variance, and means were separated by least significant difference at the 0.05 level of significance (LSD = 0.05). Ryegrass control and yield were averaged across locations. All herbicide treatments improved wheat yields over the untreated check, which showed a 35% yield loss as a result of diclofop-resistant ryegrass. The PRE and early POST applications of herbicides—Glean, Finesse, Axiom, Achieve, or MKH 6562—provided around 75% control, but yield was not different from sequential herbicide treatments of Glean, Sencor, or Finesse that provided 92% control. However, with less control, a large amount of resistant ryegrass seed escaped, allowing this weed to be a problem in the future. Treatments containing sequential herbicide applications provided no significant increase in wheat yield but allowed the least amount of diclofop-resistant ryegrass seed to be added to the soil seedbank.

CHEMICAL AND PHYSICAL REMOVAL OF COTTON FRUIT AT INSECTICIDE TERMINATION TO IMPROVE YIELDS AND CONTROL BOLL WEEVILS

Robert "Scott" Brown, D.M. Oosterhuis and F.M. Bourland, Department of Crop, Soil, and Environmental Sciences

Increasing yields in cotton (*Gossypium hirsutum*) is an ongoing concern for many researchers. It has been shown that removal of upper-canopy squares at nodes above white flower five plus 350 heat units (NAWF = 5+350 H.U.) may actually divert carbohydrates to developing bolls with a yield advantage. This study evaluated various chemical and physical methods of removing upper-canopy, late-season squares to potentially increase seedcotton yields and help control boll weevils (*Anthonomus grandis*) by removing their late-season food sources. The research was performed in Northeast and Southeast Arkansas on an early-maturing Deltapine DP20B cultivar. To allow for any potential problems in the research due to weather and to provide two growth patterns, two planting dates were included in the study (early and mid-May). The treatments for the 1999 season included a hand square removal and a mechanical topping treatment (physical removal), cyclanilide (Finish), ethephon (Prep), chlormequat (CCC), maleic hydrazide (M-H30) (chemical removal) and a control with no fruit removal. The cotton products cyclanilide and ethephon were the most effective at removing unwanted upper-canopy fruit above NAWF = 5 and helping to control

boll weevils by limiting their late-season food sources. However, weight and quality of first-position bolls at NAWF = 5 were decreased ($P < 0.05$) by cyclanilide applications. Conversely, the largest bolls were observed from the hand removal of squares and control treatments. No differences ($P < 0.05$) occurred with respect to increasing seedcotton yields, but the control gave the highest numerical yields.

TOMATO RESPONSE AND RESIDUE DETECTION FROM SIMULATED DRIFT RATES OF QUINCLORAC

Michael L. Lovelace, R.E. Talbert, L.A. Schmidt, and E.F. Scherder,
Department of Crop, Soil, and Environmental Sciences

Quinclorac (Facet) drift has been speculated as causing injury to tomato crops in Northeast Arkansas. A study was conducted in Fayetteville in 1999 to determine injury and residue level in tomatoes after treatment with simulated drift rates of quinclorac. A factorial treatment structure in a randomized complete block was used, with number of applications (one, two, or three) at weekly intervals beginning at first bloom and quinclorac rate (0, 0.42, 4.2 and 42 g ai/ha) as factors. Plant biomass was analyzed for quinclorac concentration using high-performance liquid chromatography weekly for 6 weeks after initial treatment (WAT). Injury ranged from 55 to 65% at 2 to 9 WAT with two and three applications of quinclorac at 42 g/ha, which was greater than injury from a single application (40 to 47%). Injury from multiple applications at 4.2 g/ha was 45 to 60%. Injury was less than 18% for all treatments at 0.42 g/ha. Plant fresh weight was greater from a single quinclorac application at 42 g/ha (3100 g/plant) compared to multiple applications (2100 to 2500 g/plant). Tomatoes treated with one or three applications at 4.2 g/ha resulted in a fresh weight of 5000 g/plant by 9 WAT, which was greater than fresh weight after two applications (3900 g/plant). Quinclorac at 0.42 g/ha did not affect plant fresh weight. Quinclorac concentrations were approximately 1000 and 100 ppb immediately after each application at 42 and 4.2 g/ha, respectively. Instrumentation could not detect quinclorac in plants treated with 0.42 g/ha. Tomato plants receiving one or three applications of quinclorac at 0.42 g/ha yielded 27 to 29 kg tomatoes/10-m row, which was not different from yield of the untreated check (32 kg/10-m row). Yield ranged from 10 to 12 kg/10-m row when treated with 4.2 kg/ha and 3 to 5 kg/10-m row when treated with 42 kg/ha.

ANTIOXIDANT LEVELS IN RICE BRAN AS INFLUENCED BY COMMERCIAL MILLING AND PROCESSING AND EXTRACTION METHOD

Brian J. Lloyd, Terry J. Siebenmorgen, Robert E. Babcock, and Kelly W. Beers,
Departments of Biological and Agricultural Engineering, Food Science, Chemical Engineering, and Poultry Science, respectively

Rice bran is known to contain high amounts of beneficial antioxidants including tocopherols (vitamin E), tocotrienols, and oryzanols. These lipid-soluble vitamins found in rice bran oil have been attributed to several positive health effects such as lowering serum cholesterol in humans, reduction in aortic fatty streaks in cardiovascular patients, and even anti-cancer activity. Thus rice bran is being viewed as a potential functional food source for these high-value nutrients to use as additives in foods, pharmaceuticals, and cosmetics. Current rice-milling technology produces rice bran from the various pericarp layers of the kernel bran layer usually by multi-break milling. The bran produced from these layers at different milling breaks are combined and then often steam-extruded to form a stabilized rice bran pellet, which is storage-safe prior to oil extraction. The bran produced from each stage of the milling process is expected to vary in antioxidant content. In addition, antioxidant contents are also speculated to change through the commercial stabilization process. For this project, bran from both long- and medium-grain rice was sampled and antioxidant content measured at different points in a commercial rice mill and bran processing facility. Antioxidant quantities were shown to significantly change for selected antioxidants through the process. Second, rice bran was extracted using super-critical CO_2 extraction to selectively extract more antioxidants than conventional hexane extraction. Significantly higher amounts of total oil, vitamin E, tocotrienol, and oryzanol were extracted using super-critical CO_2 extraction.

GROWTH AND YIELD OF TRANSGENIC COTTON UNDER VARIOUS WEED MANAGEMENT PROGRAMS

Michelle L. Mobley, N.R. Burgos, and M.C. McClelland, Department of Crop, Soil, and Environmental Sciences

Herbicide-resistant cotton and ultra-narrow spacing are emerging technologies that could potentially improve weed management and profitability of cotton production. A field study was conducted to compare development of transgenic cotton in conventional and ultra-narrow rows and to determine whether a soil-applied herbicide is needed in weed management programs for transgenic cultivars. Studies were conducted in Fayetteville and Little Rock in 1999. In Little Rock under conventional row spacing without a soil-applied herbicide, BXN47 was shorter and had narrower canopy than SG125, PM1220, and DP450 at any period. Plants grown in conventional row spacing were larger than those in ultra narrow rows regardless of cultivar. Plants in conventional rows also had a higher first-fruiting node, more bolls retained at second position, and more sympodia first-position bolls. In ultra-narrow row spacing, there was no difference in total bolls between PM1220 and BXN47, but in conventional row spacing, PM1220 had more total bolls than BXN47. In general, treatments with a preemergence herbicide followed by a postemergence had higher yields. Row spacing did not influence yield. In Fayetteville, canopy height and width measurements were larger for PM1220 at 45 and 60 days after planting (DAP) compared to BXN47. At 75 DAP, there was no difference in plant height regardless of cultivar, row spacing, and herbicide program. In conventional row spacing, more first- and second-sympodia bolls were produced as well as more total bolls. PM1220 retained more first- and second-position bolls than BXN47. PM1220 also had more total bolls than BXN47 in both row spacings. Plants in conventional row spacing had higher yields than those in ultra-narrow rows.

EFFECT OF pH ON DECOMPOSITION OF ORGANIC MATERIALS

Biljana (Bibi) D. Nikosavic, John T. Gilmour, and Duane C. Wolf, Department of Crop, Soil, and Environmental Sciences

Not much definitive information on soil pH and decomposition is available in the literature. The objective of this study was to characterize the effect of soil pH on decomposition of organic materials. Three soil pH regimes were established in a Captina silt loam (fine-silty, siliceous, mesic Typic Fragiudult) over a 6-month period. Final pH values, determined on 1:2 (wt/wt) soil-to-water slurry, were 4.2, 5.7, and 7.4, and final microbial biomass values were 150, 139, and 208 mg C/kg soil for the alum, control, and lime treatments, respectively. After soil pH adjustment, one-half the plots were amended with fescue (*Festuca arundinacea*) hay. One month later, paper mill sludge, sorghum sudan grass (*Sorghum bicolor*), and biosolids contained in mesh bags were inserted into the soil, and decomposition was measured by substrate weight loss. Soil samples were collected periodically during the field study and assayed for pH, microbial biomass C, and laboratory incubation studies. Percentage laboratory decomposition was calculated by CO_2 evolution. Decomposition of the organic materials was not affected by soil pH in the field study. In the laboratory, where the differences were found among the treatments, decomposition was most commonly smaller in the soil treated with alum as compared to lime.

THE ROLE OF TREHALOSE IN DESICCATION TOLERANCE OF ENDOPHYTE-INFECTED TALL FESCUE

Margaret E. Secks, Michael D. Richardson, Charles P. West, Melody L. Marlatt, and J. Brad Murphy, Departments of Horticulture and Crop, Soil, and Environmental Sciences

Tall fescue infected with a fungal endophyte (*Neotyphodium coenophialum*) has increased survival under heat and drought conditions compared to uninfected tall fescue. However, the mechanism for drought tolerance in endophyte-infected plants is unclear. Trehalose, a disaccharide, is known to accumulate in a broad range of desiccation-tolerant organisms including plants, fungi, bacteria, and invertebrates. It appears to act as a membrane and enzyme protectant in these organisms under severe water stress conditions. To determine whether trehalose is a factor in desiccation protection of endophyte-infected tall fescue, carbohydrate analysis using gas chromatography was conducted on endophyte cultures and endophyte-infected tall fescue plants. Initial carbohydrate analysis of endophyte cultures showed the presence of trehalose as well as analysis of endophyte cultures grown on osmotically adjusted media. Trehalose was synthe-

sized by endophyte cultures grown on selective carbohydrate source media. Field studies comparing well-watered and water-stressed grasses were conducted using a rainout shelter to produce consistent drought stress. Significant changes in carbohydrate profiles were found. Trehalose was present in endophyte-infected plants, but there were no significant differences between water treatments.

AN INTERACTIVE, WEB-BASED SOILS INFORMATION SYSTEM USING DIGITAL GEOGRAPHIC DATABASES FOR ARKANSAS

Kelly C. Sparks and H. D. Scott,
Department of Crop, Soil, and Environmental Sciences

Soils are a finite and vital natural resource. Soil characteristics have a major effect on how soil and land can best be used, for example in agriculture, construction site selection, forestry, rangeland, water management, and wildlife habitat issues. Information on Arkansas soils exists in soil survey reports published by the Natural Resource Conservation Service and in SSURGO (Soil Survey Geographic) and STATSGO (State Soil Geographic) digital databases. The printed soil survey reports must be obtained for each county in which the user is interested and are cumbersome and inefficient to use. The SSURGO and STATSGO digital geographic databases require the user to have specialized geographic information systems (GIS) software to interpret the information. Thus neither of these is widely accessible or convenient to the public. Geographic information systems allow qualities of soils to be displayed in map form as well as queried to provide an efficient and meaningful way to analyze and interpret soil characteristics. The Arkansas Soils Information System (ARK-SIS) provides this technology over the Internet, serving information contained in the SSURGO and STATSGO databases directly and instantaneously to the user. Combining the technologies of GIS and the Internet allows ARK-SIS to serve the digital soils information effectively and to the greatest possible number of users, allowing online mapping and query of soils information to persons in research, the government, private industry, and the public.

ALTERNATIVES TO ATRAZINE FOR WEED CONTROL IN TRANSGENIC CORN

Oscar C. Sparks, L.R. Oliver, and J.W. Barnes,
Department of Crop, Soil, and Environmental Sciences

The advent of transgenic corn cultivars that tolerate in-crop applications of nontraditional herbicides have transformed the methods by which a grower can attain superior weed control. Field experiments were conducted in 1999 at the Northeast Research and Extension Center, Keiser, on a Sharkey silty clay and at the Main Experiment Station, Fayetteville, on a Taloka silt loam to compare the weed control in glufosinate-, glyphosate-, and imidazolinone-resistant cultivars and to evaluate the need for atrazine in these systems. Each experiment was conducted as a randomized complete-block design with four replications. Experimental units were 4 by 8.2 m broadcast sown with velvetleaf (*Abutilon theophrasti*), pitted morningglory (*Ipomoea lacunosa*), entireleaf morningglory (*Ipomoea hederacea* var. *integriuscula*), large crabgrass (*Digitaria sanguinalis*), and prickly sida (*Sida spinosa*). Following incorporation of weed seeds, Dekalb 580RR, Pioneer 34A55LL, or Pioneer 3395 IR corn was planted at 65,000 seed/ha to a depth of 4 cm. There was no difference in yield between treatments receiving sequential applications of glufosinate, glyphosate, or single applications of imazapyr + imazethapyr as compared to a standard program of *S*-metolachlor + atrazine PRE followed by atrazine on four-leaf corn. The addition of atrazine did, however, improve control of pitted morningglory as compared to glyphosate at 0.84 followed by 0.63 kg/ha and single applications of imazapyr + imazethapyr at 0.063 kg/ha. Injury (16%) was noted on the glyphosate-resistant cultivar treated with metribuzin + flufenacet tank-mixed with isoxaflutole, and there was also a significant yield loss in the imidazolinone-resistant cultivar.

GLYPHOSATE APPLICATION TIMING BASED ON WEED CANOPY LEAF AREA INDEX VALUES IN SOYBEAN

K. Doug Walsh and L. R. Oliver,
Department of Crop, Soil, and Environmental Sciences

A field study was conducted during the summers of 1998 and 1999 at the University of Arkansas Main Agricultural Experiment Station in Fayetteville to determine, by total weed leaf area index (LAI), the most effective

timing for the initial application of glyphosate in narrow- and wide-row soybean production systems. The experiment was a completely randomized design. Weed seed for several species were spread across the field in varying densities in order to achieve varied weed densities. Asgrow 5601 RR soybean was planted at two-row spacings: 51 cm (wide row) and 19 cm (narrow row). Plots were 6.25 m^2 and were trimmed to 4 m^2 at soybean harvest. Glyphosate was applied over-the-top at a rate of 1.12 kg ai/ha from 7 to 56 days after emergence (DAE) and was repeated, as needed, through the growing season to prevent weed reinfestation. Prior to glyphosate application, crop and weed LAI were measured for eight wide-row and nine narrow-row plots based on plant samples taken from two 0.25 m^2 subplots. Data were analyzed using surface response analysis. Percent yield loss was predicted based on models for the two-row spacings. Predicted percent yield loss data were then analyzed by analysis of variance. Percent yield loss in wide rows was significant when the weed canopy achieved an LAI of 1 after 10 DAE. Initial glyphosate timings could be delayed up to 30 DAE for total weed LAI values less than 1 in wide rows. Percent yield loss in narrow rows was significant at weed canopy LAI greater than 0.4. Similar to wide rows, glyphosate application can be delayed in narrow-row soybean as long as the weed canopy LAI remains small. However, yield loss in narrow rows significantly increases at smaller weed canopy LAI values than wide rows, indicating a need to remove weeds earlier in narrow rows.

EFFECTS OF SUPPLEMENTATION AND NITROGEN FERTILIZATION ON STOCKER CATTLE PERFORMANCE

Jeff Weyers, Stacey Gunter, Paul Beck, and Kim Cassida,
Department of Animal Science

This research evaluated the effects of an energy supplement at two N fertilization rates (111 or 149 kg N/ha) on grazing cattle performance. In 1999, 76 steers were assigned to 12 pastures 0.81 ha in size. The supplement was fed at 0.65% of body weight (BW), and treatments within each N fertilization rate consisted of (1) nonsupplemented (NS) at a normal stocking rate, (2) supplemented (S) at a normal stocking rate, or (3) S at a high stocking rate. At the normal stocking rate, average daily gain (ADG) and gain/ha (GH) were less ($P < 0.05$) for the NS steers than S steers across fertilizer rates, but ADG and GH were greater ($P < 0.05$) for the S steers at the normal stocking rate than the high stocking rate. Steers grazing pastures fertilized at the low N rate had a greater ($P < 0.05$) ADG than steers grazing pastures fertilized at the high N rate, while the GH was greater ($P < 0.05$) for high N pastures than for low N pastures. The ratio of supplemental dry matter (DM) to added GH was lower ($P < 0.05$) for low N pastures than for high N pastures at the normal stocking rate. At the high stocking rate, the ratios of supplemental DM to added GH for steers grazing low N pastures was lower ($P < 0.05$) than for those grazing high N pastures. In conclusion, at the low N fertilization rate, supplementation seemed advantageous, but at the high N fertilization rate, poor supplemental conversions indicated that forage may have been limiting.

GERMINATION AND SURVIVAL OF FIVE PLANT SPECIES IN A PETROLEUM-CONTAMINATED SOIL

Paul White, Jr., Wes Kirkpatrick, Duane Wolf,
and Greg Thoma,
Departments of Crop, Soil, and Environmental Sciences
and Chemical Engineering

Phytoremediation is an alternative technology that could be used to remediate petroleum-contaminated soil at drilling rig sites. The goal of phytoremediation is to enhance the biodegradation rate and to lower contamination concentrations to acceptable levels. A necessary prerequisite for phytoremediation is vegetation of the contaminated soil. The objectives of the greenhouse study was to evaluate germination, survival, and growth of alfalfa, bermudagrass, crabgrass, fescue, and ryegrass in a crude oil-contaminated soil with and without amendments. Amendments evaluated were inorganic fertilizer, broiler litter, paper mill biosolids, and hardwood sawdust. Broiler litter significantly decreased seed germination, but increased shoot and root biomass in the contaminated soil. Fescue and ryegrass had the highest germination percentages. Ryegrass and crabgrass had significantly greater root surface areas than did fescue or

alfalfa. Results from the study can be used to select plant species to establish at crude oil-contaminated sites and demonstrate the benefits of adding soil amendments.

PHYSIOLOGICAL COMPARISON BETWEEN ASCITES-RESISTANT, ASCITES-SUSCEPTIBLE, AND THE RELAXED LINE OF BROILERS

Brenda D. Kidd, J. M. Balog, N. B. Anthony, G. R. Huff, W. E. Huff, and N. C. Rath,
Department of Poultry Science, USDA/ARS/PPPSR

Ascites is a metabolic disease of fast growing meat-type birds. Proper management can reduce ascites. The permanent solution to this poultry disease is genetic selection for ascites-resistant lines. The objective of this research was to determine the differences in ascites-resistant, ascites-susceptible, and the relaxed line of broilers. Broilers were reared in floor pens with feed and water for ad libitum consumption. Birds were cold-stressed at 4 hours after hatch and again on day 14 (10ºC for 5 hours) to initiate an ascitic response. At 6 weeks, the trial was terminated. Whole-body, liver, spleen, and split heart and lung weights were recorded. The lung cavity was measured, and birds were scored for ascites. Results showed body weights were not statistically different among all groups. Susceptible birds showed more right ventricular hypertrophy ($P > 0.0001$) than controls and resistant birds. Ratio of total heart to body weight was significantly higher ($P > 0.002$) in the susceptible and resistant birds. Ascites mortality was not significantly different among the lines. Lung weights in the resistant birds were significantly heavier ($P > 0.05$) than those of control and susceptible birds. Lung cavity width was significantly smaller ($P > 0.06$) in the resistant birds than the control birds. Results indicate selection for a larger heart and lungs and narrower lung cavity in the resistant line of broilers.

GRADUATE POSTER COMPETITION

WEED CONTROL IN A CLOD-FURROW SOYBEAN PLANTING SYSTEM

William P. Black, L. R. Oliver, and T. C. Keisling,
Department of Crop, Soil, and Environmental Sciences

Water imbibition by the soybean seed is a crucial step in soybean growth. The clod-furrow soybean planting system is used to ensure that the soybean seed has sufficient moisture to germinate and was developed to give producers an alternative planting system in a dry spring or early summer. The field is prepared by hipping the ground and leveling the top of the bed with a field cultivator. The beds are re-hipped, leveled, and finally rolled before irrigation. Studies to evaluate weed control in the clod-furrow system were established at Pine Tree (silt loam) and Keiser (heavy clay), on 26 May and 22 June 1999, respectively. Treatments were Treflan at 0.75 lb ai/A preplant incorporated (PPI), Squadron at 0.87 lb ai/A PPI, Dual II Magnum at 1.27 lb ai/A preemergence (PRE), Frontier at 1.27 lb ai/A PRE, Canopy XL at 0.23 lb ai/A PRE, Canopy at 0.375 lb ai/A PRE, Squadron at 0.87 lb ai/A PRE; and postemergence applications of Reflex at 0.375 lb ai/A V3 (soybean growth stage), Storm at 0.75 lb ai/A V3, Typhoon at 0.546 lb ai/A V3, Roundup Ultra at 1.0 lb ai/A V3, Roundup Ultra at 1.0 lb ai/A V3 and V6, Roundup Ultra at 0.75 lb ai/A V3, V6 and R1. AG-98 surfactant was added to all postemergence herbicides except Roundup Ultra. Each study utilized a randomized complete-block design, and means were separated by least significant difference at the 0.05 significance level. Storm, Reflex, and Typhoon were weaker than the other treatments on all weeds. Treflan, Squadron, Reflex, Storm, and Typhoon reduced soybean yields. Preemergence herbicides provided season-long control of grass species. Dual II Magnum and Frontier controlled prickly sida and entireleaf morningglory less than other treatments. Single and sequential applications of Roundup Ultra provided soybean yield and controlled weeds all season.

PHOSPHORUS AND FORAGE ANALYSIS OF POULTRY-LITTER AMENDED PASTURES

Indi S. Braden and C.P. West,
Department of Crop, Soil, and Environmental Sciences

An expanding poultry industry in Arkansas produces increasing amounts of animal waste in the form of litter. Poultry litter is commonly surface-applied on pastures as a fertilizer to promote forage growth for beef cattle production. Phosphorus build-up from long-term applications can lead to runoff losses and reduced water quality. Pastures in Arkansas consist of highly variable soils and landscape features. Litter application rates need to be varied according to the local soil conditions in order to avoid high-risk areas of runoff. Detailed analysis of the farm soils, forages, and landscape can aid in targeting litter rates in ways consistent with forage production

and water-quality goals. A commercial beef farm that uses poultry litter for fertilizer was intensively sampled for soil test phosphorus (STP) and forage composition. Maps were then compiled of STP, field boundaries, and forage species using a geographic information system (GIS). A 20-m grid pattern was sampled to study variation on a 10 to 15% slope that bordered an intermittent stream. Vegetative cover on the 20-m grid was nearly 100%. Soil test phosphorus levels far exceeded the 112 kg/ha level considered the maximum requirement for grass growth. Variation maps show a decreasing gradient of STP sloping toward the stream. The very high STP levels on this slope suggest a risk of phosphorus runoff despite the dense vegetative cover. The area of field bordering the stream is a high-risk zone of entry of phosphorus into the stream, and therefore would call for placement of a no-litter-application buffer strip. The GIS technology furnishes a useful tool for developing site-specific forage management plans that are consistent with environmental objectives.

EFFECT OF INSECTICIDE TERMINATION AT 250, 350, AND 450 HEAT UNITS ON CARBON PARTITIONING FROM UPPER-CANOPY LEAVES TO THE DEVELOPING BOLL LOAD

Robert "Scott" Brown, D.M. Oosterhuis, Charles T. Allen, and F.M. Bourland,
Department of Crop, Soil, and Environmental Sciences

The crop monitoring program COTMAN uses the concept of 350 heat units after anthesis of the last effective flower population at NAWF = 5 for termination of insecticide applications. It has been reported that terminating insecticides at 350 heat units after NAWF = 5 results in a higher yield than when terminating at either lower or higher heat unit values, although evidence is lacking. It is hypothesized that insect damage to upper-canopy (above NAWF = 5) squares results in improved partitioning of carbon to lower developing bolls. Two field studies were conducted to determine how removing this upper-canopy fruit at various heat units affected yield, as well as boll weight and fiber quality of first position bolls at NAWF = 5. Treatments consisted of a control with no fruit removal and hand removal of all upper-canopy fruit above NAWF = 5 at 250, 350, and 450 heat units. The data from the 1998 season supported the COTMAN concept of insecticide termination at 350 heat units after NAWF = 5. However, the results from the 1999 study suggested that yield and fiber quality were the highest when fruit was not removed. Further field verification is required.

PRODUCTION AND UTILIZATION OF CUCUMBER FLAVORS FOR INHIBITING YEAST GROWTH IN PICKLE BRINES

Rosa Buescher and R. Buescher,
Department of Food Science

Excessive yeast growth in cucumber pickle brines causes bloating, loss of lactic acid, and off-flavors. Sorbic acid is widely used by pickle manufacturers to inhibit yeast growth, but it is unstable and expensive. Preliminary studies indicated that cucumber flavors, trans-2-cis-6-nonadienal and trans-2-nonenal, were inhibitory to yeast growth. Objectives were to determine the effectiveness of trans-2-cis-6-nonadienal and trans-2-nonenal on yeast inhibition and factors that affect flavor production. Samples of commercial pickle brines [105 to 106 colony-forming units (CFU)/ml] were obtained as the yeast source. Effects of trans-2-cis-6-nonadienal and trans-2-nonenal concentrations on yeast growth in brines for pH (2.3 to 4.3) and NaCl (2.5 to 10%) were determined. Samples were extracted by pentane and analyzed by GC-FID (gas chromatography-flame ionization detector). Effects of cucumber juice storage, fermentation, temperature, and substrate addition on production and stability of the cucumber flavors were examined.

EFFECT OF DRILLED ROUNDUP READY SOYBEAN POPULATIONS ON ECONOMIC RETURN

Jeff T. Edwards, J.K. Norsworthy, and L.R. Oliver,
Department of Crop, Soil, and Environmental Sciences

Roundup Ready technology is an effective tool for control of many problem weeds, and Roundup Ready cultivars have been readily adopted. Increased seeding costs due to technology fees have led to a transfer of production costs from herbicide to seed expense. In 1998, a 2-year study was initiated on a Sharkey clay at the Northeast Research and Extension Center, Keiser, to determine the optimal seeding rate of Roundup Ready soybean in terms of both yield and economics. Soybean seeds were drilled in 19-cm rows with a John Deere 750 no-till drill on 2 June 1998 and 25 May 1999 at 12 rates ranging from 185,000 to 1,485,000 seeds/ha. Each plot received

a single application of either 0.56 or 1.12 kg ai/ha glyphosate when weeds reached a height of 5 to 7 cm. Weed control ratings were visually taken every 2 weeks following initial glyphosate application. Plots were resprayed with the original rate of glyphosate when control of any weed species fell below 90%. Gross margins were calculated by subtracting total weed control cost from total revenue received from sale of seed. The 988,000 seed/ha rate had the highest yield of 3,317 kg/ha and a gross margin of $539.87/ha. The 247,000 seeds/ha provided the highest gross margin of $625.00/ha. The lowest gross margin was $393.47/ha at the 1,482,000 seeds/ha planting density. The greater yields and quicker canopy closure associated with higher seeding rates were not sufficient to offset increased planting costs; therefore, the low cost of glyphosate applications relative to Roundup Ready seed indicates that producers can easily offset higher herbicide and application costs with savings from reduced seeding rates.

EFFECT OF CORONJ SLOW-RELEASE FOLIAR NITROGEN FERTILIZER ON COTTON GROWTH AND YIELD

S. Karen Gomez, D.M. Oosterhuis, and C.R. Meek, Department of Crop, Soil, and Environmental Sciences

Evidence has shown that soil fertilization cannot always meet cotton's high demand for nitrogen, and supplementation with foliar fertilizer has become a widespread practice. However, yield responses to foliar-applied nitrogen have not always been consistent. CoronJ, a slow-release nitrogen fertilizer, has been proposed as a potentially superior alternative method of foliar feeding with nitrogen. The value of CoronJ for enhancing growth and yield of cotton was evaluated in a 6-year field study in Arkansas. Foliar application of CoronJ to field-grown cotton resulted in significant ($P = 0.05$) yield increases in 2 of 6 years, with an overall average increase of 51 kg lint/ha compared to the control. CoronJ had a small, nonsignificant yield advantage compared to foliar urea alone. Furthermore, CoronJ caused a significant increase in boll weight in 1 of the 4 years that the measurement was taken, with no significant effect on boll number. The effect of CoronJ on petiole nitrate concentrations was inconsistent. From this work it can be concluded that CoronJ as foliar nitrogen fertilizer does not consistently improve cotton production.

LECITHIN AND MEDIUM-CHAIN TRIGLYCERIDES–BASED EMULSIONS IN AN ICE CREAM–LIKE PRODUCT

Agus Juliawan and Jean-Francois Meullenet, Department of Food Science

Many consumers are concerned about calories, saturated fat, and cholesterol, and there is a trend to limit fat intake, especially dairy fat. These concerns have had an impact on consumption of ice cream, butterfat, and other dairy products. Lecithin is currently used in pharmaceuticals and biomedical research as an emulsifier to create an emulsion as a medium to meet a specific nutritional requirements of target groups such as the elderly, people with human immunodeficiency virus, and children. Medium-chain triglyceride (MCT) is a modified lipid derived from saturated fats such as palm kernel oil or coconut oil that provides 6.9 cal/g. This project was undertaken with the main goal of developing an ice cream-like product using MCT, lecithin, and water. The principal objectives were (1) to optimize the process/formulation of an ice cream-like product containing various levels of MCT, lecithin, stabilizers, soy flour, and sugar by examining its rheology, texture, and structure and (2) to evaluate the sensory trails of the formulated products with a trained descriptive panel and by consumer testing. The result showed that the MCT levels influenced the size of the lipid globules in the emulsion. In addition, viscosity of the ice cream mixes increased with increasing aging time and stabilizer level. An instrumental penetrometer test allowed the optimization of the hardness of the various ice cream formulations tested. Sensory evaluation data (i.e., both descriptive and consumer testing) showed that the use of soy products such as lecithin and defatted soy flour should be minimized to maximize consumer acceptance.

MICROBIAL POPULATIONS IN PETROLEUM-CONTAMINATED ARCTIC, SUB-ARCTIC, AND TEMPERATE SOILS

Heather L. Nichols, D. C. Wolf, C. M. Reynolds, and B. A. Koenen, Department of Crop, Soil, and Environmental Sciences

Biodegradation of organic contaminants in soil is largely determined by the composition and activity of the microbial population. As part of a field program assessing the influence of temperature, nutrients, and plants on

remediation, we characterized the initial microbial status of contaminated soils from Barrow, Galena, and Annette Island, Alas. These three locations have mean annual temperatures of –11.5, –1.8, and 8.8ºC, respectively. Total plate counts were used to enumerate bacteria and fungi. Cyclohexanol-, benzoate-, and motor oil-degraders were determined using most probable number (MPN) methods. Prior to treatment, Barrow and Annette Island had significantly lower cyclohexanol-degraders than Galena with log10 MPN/g soil levels of 5.39, 5.95, and 6.91, respectively. Barrow had significantly lower benzoate-degraders compared to the Galena and Annette Island sites. Bacterial numbers, N, P, K, and Ca levels were highest at Galena, followed by Annette Island and Barrow. Initial median total petroleum hydrocarbon levels were 3,500, 2,000, and 21,000 mg/kg for the Barrow, Galena, and Annette Island sites, respectively. Microbial numbers and chemical levels of plots within a block were generally not significantly different. Biological and chemical parameters will continue to be evaluated through time to determine the effects of nutrient addition and plants on remediation of the petroleum-contaminated sites.

EFFECTS OF CALENDAR DATE AND SUMMER MANAGEMENT ON in situ DRY MATTER DIGESTIBILITY OF STOCKPILED BERMUDA

Dean A. Scarbrough, Wayne K. Coblentz, Kenneth P. Coffey, James E. Turner, George V. Davis, and D. Wayne Kellog, Department of Animal Science

Five ruminally cannulated, cross-bred steers (mean body weight = 387 kg) were used to determine the effects of calendar date and previous summer management scheme on the kinetics of in situ dry matter (DM) disappearance of stockpiled Greenfield bermudagrass. At one site, forage was stockpiled after summer hay management with high inputs of N fertilizer from poultry litter and commercial sources. At the second site, forage was stockpiled after summer pasture management with moderate N inputs. Forage samples were taken from each site under caged enclosures at 4-week intervals, beginning 17 October 1997 and ending 9 January 1998. On the basis of in situ analysis, forage DM was partitioned into three fractions. Fraction A was defined as being immediately soluble. Fraction B was defined as being digestible at a measurable rate; fraction C was defined as that part of the forage that was unavailable to the animal. At the hay site, the degradation rate decreased ($P < 0.05$) from 0.048 to 0.035/hour over the sampling period, while the potential extent of digestion decreased ($P < 0.05$) from 65.6% in October to 44.9% in January. Fraction B decreased ($P < 0.05$) between October (43.9%) and January (27.5%); fraction C increased ($P < 0.05$) from 34.4 to 55.0% over the same time period. Similar trends were observed for the forages harvested at the pasture site; however, degradation rates did not differ across dates. These data indicate that stockpiled bermuda should be utilized in late fall or early winter for optimal animal performance.

CONTROL OF *Listeria monocytogenes* ON THE SURFACE OF REFRIGERATED, READY-TO-EAT CHICKEN COATED WITH EDIBLE ZEIN FILMS CONTAINING NISIN

Marlene E. Janes, Rammakrishn Nannapaneni, and Mike G. Johnson, Department of Food Science and Center for Food Safety and Quality

Refrigerated, ready-to-eat foods can cause health problems if the prepared food is undercooked or becomes cross-contaminated with *Listeria monocytogenes* (LM). This study was conducted to determine the inhibitory activities of nisin directly added to zein edible films coated onto the surfaces of refrigerated, ready-to-eat chicken for protection against growth of LM. Cooked chicken samples (5 g) were immersed into 24-hour broth cultures of LM strain V7 for 30 seconds and allowed to drip free of excess inoculum. The meat samples were dipped into an edible zein film (Z) dissolved into either propylene glycol (ZP) or ethanol (ZE), with and without added nisin (N) (1000 IU/g) and/or 1% calcium propionate (CP). Chicken samples were placed into sterile bags and stored at 4 or 8ºC for up to 24 days. Bacterial counts were examined at 0, 4, 8, 16 and 24 days by spread-plating samples on agar medium and incubating at 37ºC for 24 hours. Upon an initial inoculation of 6.5 log colony-forming units (CFU)/g, LM grew to 8 log CFU/g by 4 days at 8ºC and by 8 days at 4ºC. Under these conditions, LM growth was reduced from 4.5 to 5 log CFU/g with ZEN, ZPNCP, and ZENCP by 16 days at 4ºC. Furthermore, ZPNCP was the most effective treatment, reducing LM by 5.0 log CFU/g by 24 days. The antimicrobial effect of nisin was lower at 8ºC, causing a 3-log CFU/g reduction for ZPN and ZPNCA by 24 days. A challenge level of 2.7 log CFU/g of LM was reduced to undetectable levels with ZEN, ZENCP, and ZPNCP from day 0 to

day 24 at 4°C. Our results indicate that zein edible films with or without nisin and calcium propionate coated on refrigerated, ready-to-eat meat products can provide additional safeguards needed to prevent possible growth of LM, which can gain entry and recontaminate meat or poultry products between the cooking and packaging steps.

A JASMONIC ACID-INDUCIBLE RICE *myb* GENE ASSOCIATED WITH FUNGAL INFECTION AND HOST CELL DEATH

Min Woo Lee and Yinong Yang,
Department of Plant Pathology

Plants defend themselves against many pathogens through induced resistance responses. Endogenous plant molecules such as salicylic acid and jasmonic acid are known to mediate complex defense signaling pathways that lead to the transcriptional activation of defense genes. As a result, pathogen-induced plant transcription factors play an important role in regulation of defense gene expression and establishment of local and systemic resistance. Recently, virus- and bacterium-induced plant *myb* transcription factors have been isolated from tobacco and *Arabidopsis*, respectively, and shown to be associated with disease resistance. In this study, we have cloned and characterized a jasmonic acid-induced rice *myb* gene (*JAmyb*) that is associated with fungal infection and host cell death. The *JAmyb* gene was induced by rice blast fungus (*Pyricularia grisea*) in both resistant and susceptible interactions. It was also induced during spontaneous lesion formation in lesion mimic mutants of rice. Interestingly, *JAmyb* was specifically activated by jasmonic acid, an effective inducer of systemic acquired resistance in rice. Together, these results suggest that the blast fungus-induced *JAmyb* transcription factor is related to host cell death and is likely involved in jasmonic acid-mediated disease resistance in rice.

DROUGHT TOLERANCE AND FOLIAR SPRAYS OF GLYCINE BETAINE

Cassandra R. Meek and D.M. Oosterhuis,
Department of Crop, Soil, and Environmental Sciences

Water is the most limiting factor in cotton production, and numerous efforts have been made to improve crop drought tolerance. Field studies were conducted in 1998 and 1999 to determine whether foliar application of glycine betaine would enhance yield in cotton under both drought and irrigated conditions. In 1998, glycine betaine-treated plants had numerically but not significantly ($P = 0.05$) greater boll numbers, bollweights, and lint yields, but no differences were significant ($P = 0.05$). In 1999, yields were inconsistent, with glycine betaine generally having no effect. No differences in photosynthetic rate between treated and untreated plants were encountered either year of the study. In 1999, plant water relation trends suggested that glycine betaine might assist in osmotic adjustment.

SPATIAL ANALYSIS OF *Alphitobius diaperinus* (COLEOPTERA: TENEBRIONIDAE) IN BROILER PRODUCTION FACILITIES

Keith O. Strother and C. Dayton Steelman,
Department of Entomology

Spatial analysis of the lesser mealworm, *Alphitobius diaperinus*, was conducted to aid integrated management of this beetle pest. A mealworm population was monitored weekly using tube traps in a broiler facility for five consecutive flock grow-outs. Litter temperature, pH, and relative humidity were measured concurrently at the same locations as tube trap placement. A geographic information system was used to display weekly spatial relationships of adult and larval beetles during each flock grow-out. A model was then created to predict areas of the facility that had high beetle numbers by analyzing weekly environmental conditions within the broiler facility. Spatial maps of beetle populations showed that the beetles occurred in the east end and center of the facility early in each grow-out and then moved toward the west end of the facility in later weeks of each grow-out. The predictive model of the beetle population reached accuracy as high 86.7% and readily displayed areas in the facility where control efforts would have the greatest impact on beetle numbers without the need to use tube traps.

TEXTURAL CHANGES IN MUSHROOMS (*Agaricus bisporus*) ASSOCIATED WITH CELL WALL COMPOSITION AND ULTRASTRUCTURE

Svetlana Zivanovic, Ron W. Buescher, and Kyung S. Kim,
Departments of Food Science and Plant Pathology

Although texture is an important quality parameter of fresh mushrooms, the understanding of what causes adverse textural changes of mushroom tissue is still incomplete. The objective of this study was to determine

ultrastructural and compositional changes in fresh mushrooms associated with adverse changes in texture after harvesting. Freshly harvested mushrooms were stored at 12ºC for 0, 3, 6 and 9 days. Softening and toughening were measured by a TA.XT2 texture analyzer by puncture and compression measurements, respectively. Scanning and transmission electron micrographs were obtained from top and center of pilei. Proteins, carbohydrates, and chitin were analyzed in sequential extracts of alcohol insoluble solids (AISs). Monosaccharides, in hydrolyzed AISs, were analyzed by gas chromatography as alditol acetates. Force for puncturing pilei declined from 2.6N to 1.5N. Toughening, expressed as gumminess, increased during the first 6 days from 19.2N to 40.3N and than declined to 33.0N. During storage, protein and total carbohydrate content declined (57.7% and 41.1%, respectively), but chitin content increased (96.7%). The dominant monosaccharide in AISs was glucose (approx. 70% of total). Other detected monosaccharides were galactose, mannose, and in lower concentrations, ribose, xylose, and fructose. Most polysaccharides were extracted after deacetylation and depolymerization of chitin, indicating that structural glucans are mainly bound with acetylglucosamine polymers. Softening paralleled expansion of intercellular space at the pilei surface, hyphae shrinkage, central vacuole disruption, and losses of proteins (R = 0.94) and polysaccharides (R = 0.84); increased chitin content was related to toughening (R = 0.95).